CLAIMS

1. A sensor, comprising:

a first amplifier having a first input, a second input, and an output;

a first resistor electrically connected in series with a first variable resistor between the output of the first amplifier and a reference terminal, the first resistor being electrically connected between the first input of the first amplifier and the output of the first amplifier, and the first variable resistor being electrically connected between the first resistor and the reference terminal;

a second amplifier having a first input, a second input, and an output;

a second resistor electrically connected in series with a second variable resistor between the output of the second amplifier and the reference terminal, the second resistor being electrically connected between the first input of the second amplifier and the output of the second amplifier, and the second variable resistor being electrically connected between the second resistor and the reference terminal; and

a voltage divider having an input that is switchably connected to one of the output of the first amplifier and the output of the second amplifier, and an output that is switchably connected to one of the second input of the first amplifier and the second input of the second amplifier, the output of the voltage divider setting a resistance of the first variable resistor when the input of the voltage divider is connected to the output of the first amplifier and the output of the voltage divider is connected to the second input of the first amplifier, and setting a resistance of the second variable resistor when the input of the voltage divider is connected to the output of the second amplifier and the output of the voltage divider is connected to the second input of the second amplifier.

2. The sensor of claim 1, wherein the voltage divider includes a programmable voltage divider.

3. The sensor of claim 2, wherein the programmable voltage divider includes a plurality of resistors connected between an output of the voltage divider and the reference terminal, and the output voltage of the voltage divider can be varied based upon which of the plurality of resistors are connected between the output of the voltage divider and the reference terminal.

4. The sensor of claim 3, wherein the output voltage of the voltage divider can further be varied based upon an amount of time each of the plurality of resistors are connected between the output of the voltage divider and the reference terminal.

5. The sensor of claim 2, wherein the programmable voltage divider includes a digital to analog converter circuit having an output that sets the output of the voltage divider.

6. The sensor of claim 5, wherein the digital to analog converter circuit includes:

a digital to analog converter having an output that provides a variable amount of current; and

an amplifier circuit having an input electrically coupled to the output of the digital to analog converter, and an output that forms the output of the analog to digital converter circuit and provides a variable output voltage based upon the variable amount of current.

7. The sensor of claim 1, further comprising a first capacitor electrically connected between the second input of the first amplifier and the reference terminal that maintains a voltage level at the second input of the first amplifier when the output of the voltage divider is connected to the second input of the second amplifier.

8. The sensor of claim 7, further comprising a second capacitor electrically connected between the second input of the second amplifier and the reference terminal that maintains a voltage level at the second input of the second amplifier when the output of the voltage divider is connected to the second input of the first amplifier.

9. The sensor of claim 1, wherein the second input of the first and second amplifiers is respectively connected to a first switch and a second switch each having an open state and a closed state, wherein a voltage level at the second input of the first and second amplifiers is sampled when the first switch and the second switch are in the closed state.

10. The sensor of claim 9, wherein the first switch receives a first switching signal that switches the first switch to the closed state after the input of the voltage divider is connected to the output of the first amplifier and the output of the voltage divider is connected to the second input of the first amplifier.

11. The sensor of claim 10, wherein the second switch receives a second switching signal that switches the second switch to the closed state after the input of the voltage divider is connected to the output of the second amplifier and the output of the voltage divider is connected to the second input of the second amplifier.

12. The sensor of claim 1, wherein the sensor is a mass flow sensor.

13. The sensor of claim 12, wherein the mass flow sensor is included in a mass flow controller.

14. The sensor of claim 1, wherein the voltage divider includes:

a third resistor electrically connected between the input and the output of the voltage divider, the third resistor being switchably connected to one of the output of the first amplifier and the output of the second amplifier;

a fourth resistor electrically connected between the second input of the first amplifier and the reference terminal; and

a fifth resistor electrically connected between the second input of the second amplifier and the reference terminal.

15. The sensor of claim 14, further comprising a first capacitor electrically connected between the second input of the first amplifier and the reference terminal that maintains a voltage level at the second input of the first amplifier when the output of the voltage divider is connected to the second input of the second amplifier.

16. The sensor of claim 15, further comprising a second capacitor electrically connected between the second input of the second amplifier and the reference terminal that maintains a voltage level at the second input of the second amplifier when the output of the voltage divider is connected to the second input of the first amplifier.

17. A sensor comprising:

a first circuit including a first resistor having a first resistance that varies in response to a change in a physical property;

a second circuit including a second resistor having a second resistance that varies in response to the change in the physical property;

a voltage divider; and

at least one switch having a first state and a second state, the first state of the at least one switch electrically connecting the voltage divider to the first circuit to set the resistance of the first resistor, and the second state of the at least one switch electrically connecting the voltage divider to the second circuit to set the resistance of the second resistor.

18. The sensor of claim 17, wherein the voltage divider has an input and an output, and wherein the at least one switch includes at least one first switch and at least one second switch each having the first state and the second state, the at least one first switch electrically connecting the input of the voltage divider to the first circuit when the at least one first switch has the first state and electrically connecting the input of the voltage divider to the second circuit when the at least one first switch has the second state, and the at least one second switch electrically connecting the output of the voltage divider to the first circuit when the at least one second switch has the first state and electrically connecting the output of the voltage divider to the second circuit when the at least one second switch has the second state.

19. The sensor of claim 18, wherein the voltage divider includes a programmable voltage divider.

20. The sensor of claim 19, wherein the output of the programmable voltage divider can be adjusted to vary the resistance to which the first and second resistors are set.

21. The sensor of claim 19, wherein the programmable voltage divider includes a plurality of resistors connected between the output of the voltage divider and a reference terminal, and an output voltage of the voltage divider can be varied based upon which of the plurality of resistors are connected between the output of the voltage divider and the reference terminal.

22. The sensor of claim 21, wherein the output voltage of the voltage divider can further be varied based upon an amount of time each of the plurality of resistors are connected between the output of the voltage divider and the reference terminal.

23. The sensor of claim 19, wherein the programmable voltage divider includes a digital to analog converter circuit having an output that sets the output of the voltage divider.

24. The sensor of claim 23, wherein the digital to analog converter circuit includes:

a digital to analog converter having an output that provides a variable amount of current; and

an amplifier circuit having an input electrically coupled to the output of the digital to analog converter, and an output that forms the output of the analog to digital converter circuit and provides a variable output voltage based upon the variable amount of current.

25. The sensor of claim 18, further comprising:

a first hold capacitor, electrically connected to the first circuit, that maintains the resistance of the first resistor when the at least one first switch and the at least one second switch have the second state; and

a second hold capacitor, electrically connected to the second circuit, that maintains the resistance of the second resistor when the at least one first switch and the at least one second switch have the first state.

26. The sensor of claim 18, wherein the at least one second switch receives a switching signal that switches the at least one second switch to the first state after the at least one first switch has switched to the first state.

27. The sensor of claim 26, wherein the switching signal switches the at least one second switch to the second state after the at least one first switch has switched to the second state.

28. The sensor of claim 17, wherein the voltage divider is shared between the first and second circuits.

29. The sensor of claim 17, wherein only a portion of the voltage divider is shared between the first and second circuits.

30. A method for use with a pair of bridge circuits each having a sensor leg that includes a fixed resistor and a variable resistor and a reference leg that sets a resistance of the variable resistor, the method comprising an act of:

sharing at least a portion of the reference leg between the first and second circuits to match the resistance of the variable resistors.

31. The method of claim 30, wherein the act of sharing includes an act of:

switchably connecting the shared portion of the reference leg to each of the pair of bridge circuits at different times.

32. The method of claim 30, wherein the reference leg includes a fixed portion and a variable portion, and wherein the act of sharing includes an act of:

sharing the variable portion of the reference leg between the first and second circuits to match the resistance of the variable resistors.

33. The method of claim 30, wherein the reference leg includes a fixed portion and a variable portion, and wherein the act of sharing includes an act of:

sharing both the variable portion of the reference leg and the fixed portion of the reference leg between the first and second circuits to match the resistance of the variable resistors.

34. A flow sensor to measure a flow rate of a fluid, comprising:

a first variable resistor;

a second variable resistor disposed downstream of the first variable resistor when a flow of the fluid is in a first direction;

a first circuit, electrically coupled to the first variable resistor, to provide a first signal indicative of power provided to the first variable resistor;

a second circuit, electrically coupled to the second variable resistor, to provide a second signal indicative of power provided to the second variable resistor; and

a third circuit, to receive the first and second signals and provide an output signal indicative of a difference between the first and second signals;

wherein a range of the output signal when the flow of fluid is in the first direction is symmetric to a range of the output signal when the flow of the fluid is in a second direction that is opposite to the first direction.

35. The flow sensor of claim 34, wherein the third circuit includes:

a first amplifier circuit to provide a third signal indicative of the difference between the first and second signals;

a second amplifier circuit to provide a fourth signal indicative of a sum of the first and second signals; and

a converter circuit to receive the third signal and the fourth signal, divide the third signal by the fourth signal to provide a divided signal, and provide the divided signal as the output signal.

36. The flow sensor of claim 34, wherein the converter circuit includes an Analog to Digital converter having a differential input to receive the third signal and a reference input to receive the fourth signal.

37. A flow sensor to measure a flow rate of a fluid, comprising:

a first variable resistor;

a second variable resistor;

a first circuit, electrically coupled to the first variable resistor, to provide a first signal indicative of power provided to the first variable resistor;

a second circuit, electrically coupled to the second variable resistor, to provide a second signal indicative of power provided to the second variable resistor;

a third circuit, to receive the first and second signals and provide an output signal indicative of a difference between the first and second signals; and

a power supply circuit, electrically connected to at least one of the first and second circuits, to provide a variable amount of power to at least one of the first and second circuits dependent upon the flow rate of the fluid.

38. The flow sensor of claim 37, wherein the power supply circuit is electrically connected to each of the first and second circuits, to provide the variable amount of power to each of the first and second circuits dependent upon the flow rate of the fluid.

39. The flow sensor of claim 37, wherein the power supply circuit decreases the variable amount of power provided to at least one of the first and second circuits at low flow rates and increases the variable amount of power provided to at least one of the first and second circuits at high flow rates.

40. A method of detecting a high flow condition in a flow sensor, comprising acts of:

determining an expected zero flow signal at a current operating temperature of the flow sensor;

determining a threshold based upon the expected zero flow signal;

determining an actual flow signal measured by the flow sensor at the current operating temperature of the flow sensor;

comparing the actual flow signal measured by the flow sensor to the threshold; and

determining that the high flow condition exists when the actual flow signal exceeds the threshold.

41. The method of claim 40, wherein the flow sensor includes an upstream circuit that provides a first output signal indicative of power provided to an upstream coil of the flow sensor and a downstream circuit that provides a second output signal indicative of power provided to a downstream coil of the flow sensor, wherein the act of determining the expected zero flow signal includes an act of determining a sum of the first and second output signals at a zero flow rate at the current operating temperature of the flow sensor.

42. The method of claim 41, wherein the act of determining the threshold includes an act of multiplying the expected zero flow signal by a constant.

43. The method of claim 42, wherein the act of determining the actual flow signal includes an act of determining a sum of the first and second output signals at a current flow rate at the current operating temperature of the flow sensor.

44. The method of claim 43, further comprising an act of preventing an amount of power provided to the upstream coil and the downstream coil from increasing excessively in response to the act of determining that the high flow condition exists.

45. The method of claim 44, wherein the act of preventing includes an act of regulating an amount of power provided to the upstream coil and the downstream coil.

46. The method of claim 45, wherein the act of regulating the amount of power includes an act of regulating a voltage provided to the upstream coil and the downstream coil.

47. The method of claim 46, wherein the flow sensor provides a sensor output signal that is based upon a difference between the first output signal and the second output signal, the method further comprising an act of setting the sensor output signal to a high value in response to the act of determining that the high flow condition exists.

48. The method of claim 47, wherein the high value is dependent upon a direction of a flow of fluid through the flow sensor.

49. The method of claim 40, wherein the flow sensor includes an upstream circuit that provides a first output signal indicative of power provided to an upstream coil of the flow sensor and a downstream circuit that provides a second output signal indicative of power provided to a downstream coil of the flow sensor, the method further comprising an act of preventing an amount of power provided to the upstream coil and the downstream coil from increasing excessively in response to the act of determining that the high flow condition exists.

50. The method of claim 49, wherein the flow sensor provides a sensor output signal that is based upon a difference between the first output signal and the second output signal, the method further comprising an act of setting the sensor output signal to a high value in response to the act of determining that the high flow condition exists.

51. The method of claim 50, wherein the high value is dependent upon a direction of a flow of fluid through the flow sensor.

52. The method of claim 40, wherein the flow sensor includes an upstream circuit that provides a first output signal indicative of power provided to an upstream coil of the flow sensor and a downstream circuit that provides a second output signal indicative of power provided to a downstream coil of the flow sensor, wherein the flow sensor provides a sensor output signal that is based upon a difference between the first output signal and the second output signal, the method further comprising an act of setting the sensor output signal to a high value in response to the act of determining that the high flow condition exists.

53. The method of claim 52, wherein the high value is dependent upon a direction of a flow of fluid through the flow sensor.

54. The method of claim 40, wherein the expected zero flow signal and the actual flow signal are indicative of a total amount of power provided to the flow sensor at a zero flow rate and a current flow rate, respectively, at the current operating temperature of the flow sensor.

55. The sensor of claim 17, wherein the sensor is a flow sensor that senses a flow rate of a fluid flowing in a conduit, the sensor further comprising:

a power supply circuit, electrically connected to at least one of the first and second circuits, to provide a variable amount of power to at least one of the first and second circuits dependent upon the flow rate of the fluid.